Lecture 1: Intro to Cell Bio

**I. The Cell**

A. Two basic parts:

1. Nucleus – contains the vast bulk of genetic material

2. Cytoplasm – contains everything else (cytosol, organelles, cytoskeleton)

**II. Observational Techniques**

A. Microscopy

1. Light – Resolving power determines strength of microscope (max = ~0.22μm)

a. Light microscopes can see down to about the size of a mitochondrion

i. Typical human cell = 10μm

b. Can observe living cells

c. Shorter wavelength = higher resolving power

2. Electron – Stronger microscope

a. Can see down to ~plasma membrane layers (1nm)

b. Requires thin sections, staining for this method is toxic

c. Easier to observe internal structures

B. Sections

1. Longitudinal – a section along the long axis of a specimen

2. Transverse (Cross) – a section cut perpendicular to the long axis of a specimen

3. Oblique – Diagonal section, halfway between longitudinal and cross section

4,. Tangential – Longitudinal section that is perpendicular to the radius

C. Differential Centrifugation

1. Separation of cellular components based on density

2. Tissue must be dissociated, then separated by repeated centrifugation

D. Cell Culture

1. *In vitro* cultures allow for studies of cell growth, differentiation, and function

2. Key technique in genetic studies and how genes affect cellular processes

**III. Intracellular Organelles**

A. Smooth Endoplasmic Reticulum

1. No attached ribosomes, appears smooth in EM scans

2. Active in lipid metabolism and detoxification of drugs (through cytochrome p450)

3. Calcium accumulation

B. Rough Endoplasmic Reticulum

1. Covered by ribosomes, appears rough in EM scans

2. Site of protein synthesis and carbohydrate addition to proteins

3. Continuous with the nuclear envelope

4. Diseases are linked to improper folding or export of proteins

C. Golgi Apparatus

1. Proteins synthesized in RER are sent to Golgi for modification and packaging

2. Packages proteins into secretory vesicles

3. Consists of membranous sacs called cisternae

a. Cis-face – convex, entry phase, closest to RER

b. Medial face – between cis and trans

c. Trans-face – concave, the exit face, furthest from RER

D. Mitochondria

1. About 1μm in length

2. “Powerhouse” – produces ATP through oxidative phosphorylation

3. Smooth outer membrane, folded inner membrane – cristae

a. Cristae increase SA for more ATP production to occur

4. Contains inter-membrane and matrix (inter-cristae) space

5. Matrix contains mitochondrial DNA and enzymes

E. Peroxisomes

1. Utilize oxygen, but do not produce ATP

2. Oxidizes organic substrates, adding H to O2, producing H2O2 (oxidase)

3. Catalase breaks down H2O2 into 2H2O and O2

4. Catabolism of long chain fatty acids

F. Lysosomes

1. Contains acid hydrolases, sulfatases, proteases, nucleases, etc.

2. Membranes compartmentalize degradative enzymes from the rest of the cell

3. Actively transports H+ in, pH ~ 5

a. Optimal enzyme activity at low pH

4. Get rid of cellular waste and process any “garbage”

G. Cytoplasmic Inclusions

1. Technically not organelles

2. Consist of accumulated metabolites, i.e. glycogen, triacylglycerol

**IV. Material Transport**

A. Gated Transport

1. Selective, ligand-gated channels that allow for diffusion of small molecules

B. Transmembrane Transport

1. “Protein translocators” directly transport specific proteins across the membrane

2. Proteins molecules usually must unfold to be transported

C. Vesicular Transport

1. Soluble proteins are transported to Golgi and packaged in vesicles

2. Vesicles pinch off from source and fuse with the target compartment

D. Endocytosis

1. Phagocytosis – ingestion of large, insoluble particles (i.e. bacteria)

2. Pinocytosis – ingestion of smaller, soluble particles

3. Autophagy – membrane forms around nonfunctional self and fuses with lysosome

**V. Cell Death**

A. Necrosis

1. Cell death that occurs following injury

2. Disorganized breakdown of tissues

3. Releases cellular contents, may trigger immune response

B. Apoptosis

1. Programmed cell death

2. Organized and compartmentalized breakdown of cells

3. No inflammatory processes

4. Condensation of chromatin (pyknosis), mark of apoptotic cells in micrographs